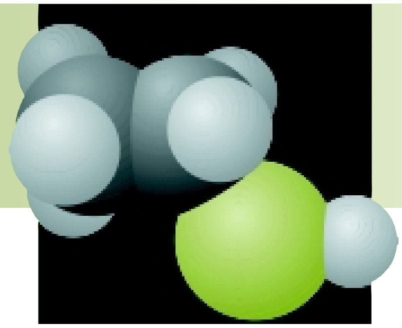
CHEMICALS

Project Fact Sheet



ALLOYS FOR ETHYLENE PRODUCTION

BENEFITS

- Potential energy savings of 420 trillion Btu annually
- Optimized reaction conditions
- Improved coking resistance provides significant productivity gains
- Improved equipment lifecycle with fewer maintenance shutdowns

APPLICATIONS

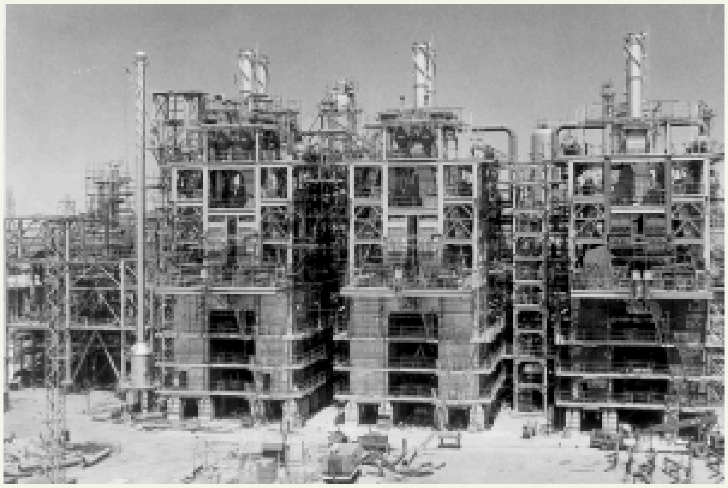
Intermetallic and advanced metallic alloys have been developed for a number of industrial processes. Their first chemical industry application utilizes coking and carburization resistant intermetallics for ethylene furnace tubes. These intermetallic and metallic alloys may also be applied to other chemical processes and to other industries including petroleum refining, steel, heat treating, and forging.

NEW ALLOYS WILL INCREASE THE LONGEVITY OF ETHYLENE FURNACE TUBES

The production of ethylene is classified as one of the most energy intensive processes in the chemical industry due to the decoking necessary to maintain ethylene furnace tubes. Traditionally, ethylene furnace tubes were fabricated from cast or wrought, high alloy stainless steels. Coke layers form on the inside surface of these tubes during normal operation, causing reduced mass flow through the tube and heat transfer across the wall of the tube. In addition, carburization, or the formation of metal carbides along the tube wall, further limits the furnace tube's structural life.

Project partners will develop intermetallic and metallic materials that allow for the production of ethylene furnace tubes resistant to coking and carburization. Preliminary studies have already shown an improvement in resistance to carburization, and reduction in the development of coke layers. Project partners will focus on iron and nickel aluminide intermetallics and on advanced metallic alloys for application into separate layers of the tube. Novel tube fabrication methods and welding techniques will also be implemented during the production process.

ETHYLENE FURNACES



Six modern conventional ethylene pyrolysis furnaces in the final stages of construction. The naphtha plus steam feed is preheated in the (upper) convection sections and then further heated in the lower radiant coils where the thermal cracking reactions occur producing an ethylene/propylene rich product stream.

Project Description

Goal: Develop and commercialize ethylene furnace tubes based on iron and nickel aluminides and advanced metallic alloys including silicon-containing alloys and other alloys.

The work in this project will be divided into three main tasks. First, work will begin with developing a tube fabrication method for applying a thin layer of FeAl on the inside of currently used alloys. This will be achieved using three possible methods: co-extrusion, bimetallic casting, and weld overlay. Secondly, since the current Ni_3Al composition is not resistant to coking, research will also identify a new intermetallic composition resistant to coking. The third area of focus will consist of developing advanced metallic alloys including Fe-Cr-Si alloy as a coating and Ni-Cr-Si alloy as a monolithic tube. Like aluminides, research has shown that silicon containing alloys and certain other alloys also prevent coking and carburization.

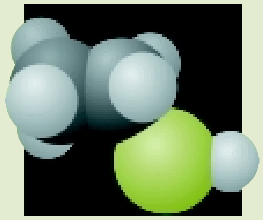
Progress and Milestones

Project research will focus on the following areas:

- Diffusion calculations for aluminum diffusion into substrate of bimetallic tube
- Laboratory coupon testing for catalytic coking and carburization
- Fabricating short section of clad tubes in laboratory
- Laboratory testing of clad tubes
- Development of welding procedures for FeAl-clad and advanced metallic alloy tubing
- Commercial production of FeAl-clad tubes and advanced metallic alloy tubes based on laboratory data
- In-plant testing of commercially produced tube

Commercialization

Alloy development, fabrication, and industrial testing occur in parallel for this project since project partners include a research organization, material producers, and multiple end-users. Once the chemical companies are satisfied with the materials performance data, they will begin implementing this technology in their facilities. Also involved in this project is a company that does not produce ethylene, but is interested in using the materials developed for other processes.



Project Partners

Oak Ridge National Laboratory
Oak Ridge, TN

Exxon Chemical Company
Baytown, TX

Air Products and Chemicals, Inc.
Allentown, PA

Akzo Nobel Chemicals, Inc.
Dobbs Ferry, NY

BP Amoco
Naperville, IL

Duraloy Technologies, Inc.
Scottdale, PA

Equistar Chemicals, LP
Cinncinnati, OH

Inco Alloys International, Inc.
Huntington, WV

Materials Technology Institute
St.Louis, MO

Nooter Fabricators, Inc.
St.Louis, MO

Sandvik Steel Company
Sandviken, Sweden

Shell Chemical Company
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